DOCUMENT RESUME

ED 373 056 SP 035 406

AUTHOR St. Clair, Barbara; Hough, David L.
TITLE Interdisciplinary Teaching: A Review of the Literature.
INSTITUTION Southwest Missouri State Univ., Springfield. Dept. of Curriculum and Instruction.
SPONS AGENCY Missouri Coordinating Board for Higher Education, Jefferson City.
PUB DATE Dec 92
NOTE 32p.
PUB TYPE Information Analyses (070)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Curriculum Design; Educational Philosophy; Educational Research; *Integrated Curriculum; *Interdisciplinary Approach; Intermediate Grades; Junior High Schools; Literature Reviews; Middle Schools; Research Needs; Student Development; *Teaching Models

ABSTRACT

This review examines both the popular and research literature on interdisciplinary teaching and learning at the middle grades level. The review discusses terminology; the rationale for integrating learning; and such features of the interdisciplinary approach as a curriculum plan demonstrating "connectedness," a holistic approach, preparation for citizenship, problem-solving, and teacher collaboration. Despite a multiplicity of terms and models, most interdisciplinary teaching plans are found to exhibit such common denominators as use of student-oriented and process-oriented methods of instruction, and emphasis on application and synthesis of content and skills. Interdisciplinary teaching has become an integral component of the middle level philosophy since the mid-1960s. While a good deal of useful information regarding the design of integrated curricula and the implementation of interdisciplinary units pervades the literature, little empirical evidence regarding student achievement or cognitive processes has been produced. The majority of studies have concentrated on teachers' and students' affect and the learning environment. The review concludes that research about the nature of young adolescent learners suggests that interdisciplinary curricula and instruction holds promise as a way of meeting middle grades students' developmental needs by making the subject matter relevant to real life and thus engaging them in the learning process. (Contains approximately 80 references.) (JDD)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED 373 056

INTERDISCIPLINARY TEACHING:

A Review of the Literature

Barbara St. Clair

David L. Hough

Southwest Missouri State University

Department of Curriculum and Instruction

PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

D Hough

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC).

December, 1992

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

This research is supported by a grant from the Missouri Coordinating Board for Higher Education, Eisenhower Cycle IX. The opinions presented are those of the authors, and no official agreement by CBHE, Eisenhower Cycle IX, or Southwest Missouri State University should be inferred.

SB 35406

BEST COPY AVAILABLE

INTERDISCIPLINARY TEACHING:
A Review of the Literature

Abstract

This review examines both the popular and research literature on interdisciplinary teaching and learning at the middle grades level. Despite a multiplicity of terms and models, most interdisciplinary teaching plans exhibit several common denominators: Teachers present content from more than one vantage point or discipline; the connections between subject areas are made explicit; there is an increased emphasis on application and synthesis of content and skills; methods of instruction and inquiry are frequently student-oriented and process-oriented, with a shift in the teacher's role from lecturer to facilitator; collaboration and communication between teachers are emphasized; the content studied promotes meaningful inquiry by demonstrating logical connections, not isolated and/or fragmented skills; and there is an underlying belief that interdisciplinary teaching motivates both teachers and students.

Interdisciplinary teaching has become an integral component of the middle level philosophy since the mid-1960s and is considered by many to be the single most distinguishing feature separating middle schools from more traditional junior high schools. While a good deal of useful information regarding the design of integrated curricula and the implementation of interdisciplinary units (as well as teacher teaming experiences) pervade the literature, little empirical evidence regarding student achievement or congitive processes has been produced. The majority of studies have concentrated on teachers' and students' affect and on the learning environment.

The rationale that undergirds interdisciplinary teaching appears to be sound conventional wisdom. The shibboleth driving interdisciplinary approaches to teaching and learning seems to be generally accepted by middle school proponents. While few studies dealing with student learning have yet to be amassed, a good deal of tangential research about the nature of young adolescent learners would suggest that interdisciplinary curricula and instruction holds promise as a way of meeting middle grades students' developmental needs by making the subject matter relavant to real life and thus engaging them in the learning process.

Introduction

Background

Interdisciplinary teaching, broadly defined as the integration of two or more disciplines, has appeared in educational literature for many years. A primary focus for interdisciplinary teaching, the "core curriculum," evolved in the late 1920's as part of the Progressive Education Movement (Vars, 1969). Tyler (1949) listed integration as one of three criteria for effective organization of the curriculum. More recently interdisciplinary teaching has come to the fore as an important component of middle level education (Alexander and George, 1981; Beane, 1986; Carnegie Council on Adolescent Development, 1989).

Terminology

The term "interdisciplinary" is applied to a variety of curricular arrangements and is frequently used interchangeably with a variety of synonyms (eg., multi-disciplinary, transdisciplinary, thematic teaching, integrated learning, et cetera). In her review of interdisciplinary approaches to the curriculum, Jacobs (1989) defines interdisciplinary as "a knowledge view and curriculum approach that consciously applies methodology and language from more than one discipline to examine a central theme, issue, problem, topic, or experience" (p. 8).

Relan and Kimpston (1991) arrange interdisciplinary approaches to the curriculum along a continuum of operational schemes, indicating the degree of integration. Thus, one extreme of the continuum would be structuring the curriculum plan around each separate subject, with the opposite extreme being an "eclectic" or "problem-oriented" approach. In between lie techniques such as the intermingling of disciplines (sometimes called "multi-disciplinary") or the integration of across-the-domain skills such as problem-solving or writing across the curriculum.

A useful organization of integrated learning methods is offered by the North Carolina State Department of Public Instruction (1987):

A. Content Within a Subject or Skill Area

One of the simplest forms of integration involves looking internally to one subject or skill area. Using Social Studies as an example, this involves an interweaving of history, geography, political science, anthropology, psychology, and sociology.

B. Skills with Subjects

This involves the utilization of selected skills in all disciplines and programs of study. "Writing Across the Curriculum" computer skills, and thinking skills are examples.

C. Subject with Subjects

Subject into subject integration has typically occurred around thematic topics where two subjects are blended together and then block-scheduled or presented as a unique elective. Examples might include History of the Arts, Humanities, Science and Health.

D. Skill with Skills

Besides a relevance to the various disciplines, skill areas relate to each other. For example, Thinking Skills and Guidance Skills go hand in hand. Skill areas are simply a part of the entire curriculum.

E. Skills/Subjects with Skills/Subjects

Total integration is a combination of all of the above, mixing skill a[illegible] subject areas. It involves all programs of study with varying degrees of emphasis. It is typically developed around a theme, problem, question or issue. (pp. 1 - 2)

One criticism of the terminology regarding interdisciplinary teaching is leveled by James Beane, who advocates, at least at the middle school level, abandoning the separate subject approach and organizing the curriculum around integrated themes. He states that "interdisciplinary teaming has most often had more to do with teaming than with interdisciplinary curriculum" and "what we claim is interdisciplinary is really multi-disciplinary, in that it retains the identity and priority of separate subjects" (Beane, 1992, p.35).

Others insist that *multi-disciplinary* should be used to identify an integrated curricula within a single classroom, presented by one teacher, while *interdisciplinary* should be used to identify integrated curricula across two or more classrooms, presented by two or more teachers. With no intention of entering into a debate over these semantics, the term *interdisciplinary* will be used throughout this review to include all of the various definitions, orientations, and perspectives one might associate with integrated subject matter presented to a common group of students.

Integrating Learning for the Young Adolescent

The Rationale

Interdisciplinary team organization is a central feature of 90% of the middle schools identified as exemplary by George and Oldaker (1985). Those who argue for an interdisciplinary approach to teaching and learning at the middle grades level often provide rationales that can be grouped, generally, into the following six statements:

An interdisciplinary approach . . .

1. is congruent with what is known about the learning styles and needs of the young adolescent learner

2. represents a positive "classroom environment fit" for young adolescents and, therefore, enhances the learning process, even achievement.

3. is a more holistic approach and, therefore, gives students a more holistic view of the world.

4. is more interactive and more global in content, preparing students better for citizenship in the 21st century.

5. improves problem-solving ability by presenting multi-faceted material and differing views.

6. promotes teacher collegiality and collaboration while alleviating isolation.

A Separate Program for a Separate Developmental Stage

Many middle level educators define "successful" or "exemplary" middle level schools as those that provide programs especially designed to meet the vast range of developmentally diverse needs of young adolescent learners, ten to fifteen years of age. Eichhorn (1983) suggests that "effective programs are those which have a causal relationship with learner characteristics" (p.45). The proliferation of middle level research and the increasing shift from traditional junior high organizational structures to middle school orientations over the past three decades (Hough, 1989), along with a general acceptance among many practioners of a cognomen (i.e., "transescent") to identify young adolescence, indicate that this age group has been recognized as a distinctly separate developmental stage (Alexander and George, 1981; Eichhorn, 1983; Toepfer, 1992a).

Eichhorn defines transescence as

> the stage of development which begins prior to the onset of puberty and extends through the early stages of adolescence. Since puberty does not occur for all precisely at the same chronological age in human development, the transescent designation is based upon the many physical, social, emotional, and intellectual changes in body chemistry that appear prior to the puberty cycle to the time in which the body gains a practical degree of stabilization over these complex pubescent changes (1983, pp. 45-46)

Curriculum theorists argue that this developmental stage is distinct enough to warrant an instructional program that is, likewise, different from that of either elementary or high school (see, e.g., Alexander and George, 1981; California League of Middle Schools, 1987; Carnegie Council on Adolescent Development, 1989; Eichhorn, 1983).

Increasing support is being given to a middle level curriculum that embodies an interdisciplinary, non-departmentalized approach as being developmentally appropriate (Beane, 1992; Carnegie, 1989; Lounsbury and Vars, 1978; Toepfer, 1992a). Beane proposes a completely thematic curriculum "based upon the idea that the primary purpose of the middle school itself should be general education: that is, education that is concerned with the common needs and interest of young people" (1992, p. 2).

Meeting Young Adolescent Learner Needs

What are the needs of transescent youth, and why is interdisciplinary teaching considered developmentally appropriate? Four characteristics of transescence have important implications for the curriculum: (a) the great diversity of maturation levels (Eichhorn, 1983; Toepfer, 1992a); (b) the likelihood that a majority of students will be at a plateau of cognitive development

(Epstein, 1974; Toepfer, 1981); (c) the fragility of self-concept and the concomitant danger of self-perpetuating failure (Stipek and MacIver,1989); and, (d) normal but increasingly dangerous experimentation with social roles, including sex, drugs, and violence (Jackson and Hornbeck, 1989).

Middle level teachers have long experienced problems associated with using a high school model to teach transescent youth. Teachers have been aware of the great diversity of reading levels, cognitive ability, physical maturity, and interest levels even within a single class. Departmentalized content-specific approaches, perhaps, only exacerbate an already convoluted situation. The range of physical, social, emotional, and intellectual development is greater in grades five through nine than at any other time of schooling (Toepfer, 1992a) and presents a monumental challenge to the curriculum.

Research on brain growth periodization and cognitive development suggests a physiological explanation for the diversity: the varying maturation rates leading to puberty and the possible correlation to a plateau in brain growth (Epstein and Toepfer, 1978). Epstein's studies indicate that rather than developing at a linear rate, the brain grows periodically, with eighty-five to ninety per cent of learners experiencing brain growth spurts between the ages 2-4, 6-8, 10-12, and 15-16+ (Epstein, 1974). Evidence suggests that these spurts correlate in age with learning capacity and "may turn out to be the biological basis of the Piaget stages [of cognitive development]" (Epstein and Toepfer, 1978, p. 657).

Many middle school researchers warn that the curriculum, both in content and approach, must address this new information (Eichhorn, 1984; Hester and Hester, 1983; Toepfer, 1992b). The implications are that during the plateau ages of 13-15, students will assimilate little new thinking capacity and will remain at the level of concrete rather than formal cognitive operations. If this is the case, the traditional justification for departmentalization no longer holds: a heavy

dose of new material which demands higher order thinking skills that is taught by a curriculum "specialist," may not be the optimal model to promote learning at this age. Perhaps, instruction in critical thinking and problem solving can capitalize on "the facts" young adolescents have already acquired and foster an interest in obtaining more information while simultaneously nurturing the cognitive processes necessary to make the transition from concrete to formal operations. Unfortunately, some have misinterpreted this to mean that transescents are not capable of learning much new material and, therefore, suggest that the middle grades should concentrate on skill, drill, and repetition. This latter approach is neither logical nor appropriate for young adolescents who evidently seek continually to explore new situations.

A Curriculum Plan Demonstrating "Connectedness"

Interdisciplinary units focusing on personal and societal issues important to transescents are seen as vehicles for exploring choices and developing decision-making skills (Beane, 1992; Lounsbury and Vars, 1978). Beane states that "If we want genuine learning, we must begin with the questions and concerns of young adolescents and help them to find answers and meanings that they may integrate into their understanding of themselves and their world. In short, we must ask, 'What sort of curriculum is most likely to be "integrative" for young adolescents' " (1992, p. 36).

Comparing the curriculum models of several theorists, Eichhorn (1984) observes that an interdisciplinary approach is important to each as a way of addressing the young adolescent need to understand how knowledge and learning are connected:

> Another common element in the models deals with the interrelationships of knowledge. Emphasis is placed in common learnings without regard to the constraints of the various disciplines. There is a recognition that presenting skills

and concepts in a practical problem-solving context will enhance learning. There is provision for 'open-ended' curricula. (p. 36)

Theoretically, an interdisciplinary curriculum would allow students to build on what they **can** do, would facilitate learning skills, would allow opportunity for exploration and application of both knowledge and skills, and would make explicit the connections between curricular areas that concrete operational thinkers cannot make (Carnegie, 1989; Hester and Hester, 1983; Toepfer, 1992a). An interdisciplinary unit would also address the dilemma of the middle level student who has developed more rapidly than his or her peers and is making the transition to formal operations, providing the student with a safe opportunity for intellectual risk-taking (Irvin, 1992).

This need to feel safe and capable occurs at a time when there is a sharp decline in perceived competence (Stipek and MacIver, 1989) and a growing conflict between the need for independence and the need for acceptance (Arhar, 1992). The shift to departmentalized instruction during the middle grades can exacerbate a transescent's sense of insecurity by increasing comparisons with other students, due to common assignments and less individualized or criterion-referenced grading. Additionally, "the tasks used to teach a given subject tend to tap a narrow range of students' skills and usually define only a limited range of performance dimensions as being important for judging success or failure" (Stipek and MacIver, 1989, p. 533). The transition from a student - teacher - centered curriculum to a subject-centered curriculum increases the likelihood that many students will receive negative messages about their ability (McPartland, 1987). Toepfer also raises concern for "turned-off learners" who may have been overchallenged during the plateau period of brain growth, noting that these learners did not later reverse their poor achievement (1992a).

Arhar (1992), Beane (1992), Toepfer (1992a), and others have recommended

interdisciplinary teaching as a way to avoid the frustration and negative self-perceptions of a curriculum that is overchallenging or overcompetitive. An integrated unit can provide an opportunity for a greater range of cognitive tasks for a student to perform and on which to be evaluated. Breaking the bonds of strict subject disciplines allows teachers to be more student-oriented, decreasing the sense of anonymity and alienation many students experience as they leave elementary school (Arhar, 1992; McPartland, 1987).

An increased tendency for risk-taking behavior, particularly as these young adolescents explore new social roles, impacts the curriculum, as well. The normal shift in identification from family to peers provides increased peer pressure to engage in adult behaviors such as sex, smoking, drinking, or using illicit drugs. According to retrospective reports of graduating seniors in 1986: initial use of cigarettes was begun by 53% prior to 10th grade; initial use of alcohol by 55% prior to 10th grade; initial use of marijuana by 26% prior to 10th grade (Jackson and Hornbeck, 1989). There is a steady rise in the number of young adolescents who are sexually active with the accompanying risks of pregnancy and sexually transmitted diseases such as AIDS (Carnegie, 1989). *Turning Points* refers to early adolescence as a time when "many youth enter a period of trial and error, of vulnerability to emotional hurt and humiliation, of anxiety and uncertainty that are sources of unevenness of emotions and behavior associated with the age" (Carnegie, 1989, p. 21).

Preferred Classroom Environment Fit

Using the rationales given for creating environments conductive to learning, a useful syllogism can be constructed for interdisciplinary teaching: If interdisciplinary teaching offers material that is selected on the basis of its relevance to the lives of middle level students and, if the content is then presented in such a way as to demonstrate common connections, and if

relevance and "connectedness" enhance learning, then one might reasonably conclude that student learning would be enhanced under such conditions.

Studies analyzing school effectiveness draw a correlation between learning climate and student behavior and achievement (e. g., Eccles and Midgely, 1988; George and Oldaker, 1985; MacIver and Reuman, 1988). The use of instruments like the Moos' Classroom Environment Scale (CES) and the Learning Environment Inventory have been used successfully to assess student perceptions in different classroom settings (Fisher and Fraser, 1983). Theoretically, a "better fit" between classroom practices and the needs and perceptions of students will enhance students' motivation and, therefore, lead to improved achievement.

The transition from elementary to junior high school is typically characterized by an increase in the number of teachers a student will see in one day and a shift from student-oriented to subject-oriented curricula (Carnegie, 1989). In schools with seventh-grade cohorts, Hough (1989) found that the seventh grade program became progressively more student-centered as lower grade levels were included in the school. At the same time, seventh grade programs became progressively more subject-centered as higher grade levels were included in the school. There is a simultaneous change in students' attitudes toward school, with students "less involved in schooling, less motivated, and thus, less likely to continue to perform as well academically" (Thomason and Thompson, 1992). There is a positive correlation between student achievement and effective middle schools, which employ techniques such as interdisciplinary teaching and team-building to shift back to a student-oriented curriculum (George and Oldaker, 1985). Sixty-eight percent of the middle schools recognized in the "Schools of Excellence" program have interdisciplinary units in place, whereas only twenty-nine percent of the schools in the random group do (George, Stevenson, Thomason, and Beane, 1992, p.71).

The perceived relevance of the subject material is a significant determinant of motivation

and achievement for the student (Beane, 1992; MacIver and Reuman, 1988; Midgely et al., 1988). Arguing for a total integration of the curriculum, Beane suggests that,

> Authentic and powerful learning occurs when interactions with our environment are integrated into our scheme of meaning. . . . If we want genuine learning, we must begin with the questions and concerns of young adolescents and help them to find answers and meanings that they may integrate into their understanding of themselves and their world. (1992, p.36)

If students are allowed to participate in the selection, arrangement or evaluation of interdisciplinary units, that opportunity for autonomy and choice also should enhance motivation. In general,the opportunities to participate in decision-making become increasingly rare in subject-oriented junior high schools. In a study of 1,823 sixth grade students, MacIver and Reuman found that "students who experienced a lack of decision-making in their mathematics classrooms perceived mathematics to have less intrinsic and utility value than did students who had more decision-making experiences" (1988, p. 32). In a similar longitudinal study of students before and after transition to junior high school, Midgely found that students' perceptions of the usefulness and importance of math interacts with achievement level (Midgely et al, 1988).

A questionnaire was administered to 700 middle-level students in Kentucky over a five-year period to assess their attitudes toward interdisciplinary units. Student perceptions of the degree of learning and the level of interest were high. According to researcher Strubbe, "If the topic is perceived as interesting, students get mentally involved, exert effort, produce quality work, learn more and feel satisfied with their performance" (Strubbe, 1990, p. 38).

Holistic Approach

Traditional junior high school schedules place students into departmentalized units or "disciplines", usually forty to fifty minutes in duration and taught by subject area "specialists" who have been trained in secondary methods to maintain the integrity of the discipline. This approach, patterned after the comprehensive high school program, may have been a natural outcome of both the industrial revolution and, later, Sputnik, which fostered a desire for specialization and academic achievement. Paradoxically, the exponential growth of knowledge and proliferation of new disciplines makes such specialization no longer viable: it is impossible to teach all of the subjects, or to teach all of the content in any one subject. In addition, issues of interest and concern to students require the insight and information of a variety of subject areas. The artificial departmentalization of most schools does not represent the integration and complexity of the real world (Relan and Kimpston, 1991).

In a traditional departmentalized curriculum, students are left to make their own connections between / among subject areas. Further, it is assumed that students will take the skills and knowledge from one discipline and be able to apply them to a larger problem in real life. Proponents of integrated learning maintain that by approaching content holistically the connections will be more clear and more "true to life" (Jacobs, 1989). In the examination of an environmental issue, for example, science, health, mathematics, history, and language arts all might offer information and perspectives toward achieving a holistic construct of the issue. If studied as part of an interdisciplinary unit, the issue would become a whole that had validity "beyond the disciplines" -- a "metaconceptual bonus" (Jacobs, 1989). Implicit in this argument is the assumption that a holistic construct is both better and more transferrable than the sum of the fragmented parts.

Preparation for Citizenship

In its 1989 report *Turning Points*, the Carnegie Council on Adolescent Development cites good citizenship as one of its goals for the nation's youth. Specifically, it calls for a fifteen-year-old who "is a doer, not an observer", who will be able to assess the historical and current practices of the government and "will participate in appropriate ways in creating and maintaining a healthy community", and who will embody "a positive sense of global citizenship" (Carnegie, p.16).

Proponents of curriculum integration see interdisciplinary teaching as a way to promote the goals of participatory democracy and global citizenship (Savage, 1991; Beane, 1992; Boyer, 1991). Calling for an organization of the curriculum around shared experiences, Boyer (1991) states that,

> the mission of general education is to help students understand that they are not only autonomous individuals, but also members of a human community to which they are accountable. In calling for a reaffirmation of general education, the aim is to help restore the balance. By focusing on those experiences that knit isolated individuals into a community, general education can have a central purpose of its own. (p. 582)

Beane recommends that the middle level curriculum be centered around thematic units that interrelate the personal concerns of early adolescents and the larger issues that face our world. Such units would foster social action and global concerns, according to Beane, if they met the following criteria:

- explicitly involve questions from the young adolescents who will carry out the unit;
- involve a concern that is widely shared by young adolescents, involve larger

BEST COPY AVAILABLE

world concerns that are of clear social significance;

- potentially engage a wide range of knowledge and resources, pose opportunities for in-depth work;
- present possibilities for a wide range of activities;
- present possibilities for action, including outside the school (1992a, p. 39).

Many school districts are making efforts to move the social studies curriculum away from the didactic presentation of historical facts to an integrated study of contemporary issues and problems, particularly in the middle grades. In 1990, for instance, the National Commission on Social Studies in the Schools recommended that the emphasis at grades seven and eight be on local history and community issues (Savage, 1991). The Missouri Department of Elementary and Secondary Education and the Department of Natural Resources funded the development of an integrated history-heritage curriculum for all seventh-grade classrooms in the state. Scheduled for implementation in 1994, this eighteen-week-long unit, called MissouriFind (or MoFind) is being develped by a consortium of Southwest Missouri State University and Ozarks Public Television (KOZK/KOZJ) personnel. The goal of the MoFind project is to provide students with opportunities to discover connections between themselves and the world in which they live. While history provides the curriculum's structure, middle level educators are calling for increased synthesis in social studies. According to Boyer, "As a global society we simply cannot afford a generation that fails to see or care about connections" (1991, p. 583).

Improving Problem Solving Ability

Most educators would agree that "the ultimate purpose of learning is to use knowledge in meaningful ways" (Marzano, 1992, p.15). The use of knowledge and skills for problem

solving is a stated goal in every academic discipline. The American Association for the Advancement of Science urges teachers to give students practice in applying ideas in novel situations (Rutherford and Ahlgren, 1990). The National Council of Teachers of Math selected problem solving as one of the four cornerstones of its Curriculum and Evaluation Standards for School Mathematics (House, 1990). The National Commission on Social Studies in the Schools proposed a middle level curriculum focusing on local problems and issues (Metcalf, 1991).

Problem solving is defined in a variety of ways. Champagne and Klopfer define it as the "ability to solve problems and think reflectively" (1981, p.3). John Dewey described a problem as anything that gives rise to doubt or uncertainty, and problem solving as the process of removing that doubt or uncertainty. Frequently problem solving is delineated by the operational steps employed by the student: judgment, critical thinking, reasoning, the scientific method, evaluation, analysis, synthesis, and other higher order thinking skills. Johnston and Markle (1986) suggest that the lack of a detailed definition of problem solving is one of the causes of the school's failure to develop problem-solving skills.

Despite the lack of agreement on a definition of problem solving, there seems to be a consensus that whatever the skills and processes involved are, American students have not adequately mastered them. National and international studies show American students as below average in problem solving, ability to make generalizations, ability to compare and contrast, and ability to write analyses or to demonstrate higher order thinking skills (Jackson and Hornbeck, 1989). The response to these findings has been a call for more research on the cognitive processes involved in problem solving (Johnston and Markle, 1986) and for increased student practice in applying knowledge and skills to new situations (Champagne and Klopfer, 1981; Jackson and Hornbeck, 1989; Yeotis and Hosticka, 1980; Rutherford and Algren, 1990).

The middle grades are a logical place to begin extensive instruction in problem solving

because this is the developmental stage at which the transition from concrete operational thought to formal operational thought most begins to occur for most people. Although there is danger in creating a mismatch between instruction and appropriate cognitive abilities of transescent youth (Toepfer, 1992a), Alexander and George recommend that middle level students be offered opportunities for "limited problem solving, evaluation of ideas, critical thinking and related processes" (1981, p.77). To facilitate the integration of new information with prior knowledge and developing skills with mastered skills, many educators are advocating a shift in middle level education from **instruction** to **construction** (Loucks-Horsley et al, 1990; Rutherford and Ahlgren, 1990; Beane, 1986). Yeotis and Hosticka (1980) suggest that the environment may need to be specially designed to aid in this transition.

As an organizational structure, interdisciplinary teaching has the potential for enhancing student problem solving ability. By focusing the curriculum on a problem or topic rather than on a discrete discipline, there is an increased opportunity to formalize the **process** of problem solving. By approaching a problem or topic from the vantage point of many teachers and/or disciplines, students are exposed to more information and more views, providing them with the raw material needed to construct understanding. Similarities among the disciplines can also enhance problem solving by revealing patterns in skills or methodology (Bell and Bell, 1985).

Relevance is a determinant in problem solving: students are more likely to attend to and reflect upon problems that are interesting and relevant to them (Johnston and Markle, 1986). The National Council of Teachers of Mathematics (NCTM) proposes that "activities should grow out of problem situations" and "students' need to experience genuine problems regularly" (1992, pp. 9-10). Perkins (1991) emphasizes that "learners do not achieve well-understood and actively used bodies of knowledge through rote learning. Rather, thoughtful learning rich with connection-making is needed for insight and for the lively and flexible use of knowledge" (p.6).

Promotes teacher collaboration

Interdisciplinary teaching has gained recognition as an organizational structure with significant benefits for the teachers involved (Meichtry, 1990; Plodzik and George, 1989; Doda, George, and McEwin, 1987). Whereas the traditional junior high school consists of individual classrooms where teachers work in isolation from their colleagues, without professional support or access to a common pool of knowledge or experience, more flexible middle school schedules allow for a common planning time for teachers to develop collegiality. Teams of teachers can work together to design and/or implement thematic units to a group of students common to the team. Because of the necessary communication and collaboration involved in integrating a lesson or unit, interdisciplinary organization becomes a fundamental way to eradicate teacher isolation and foster interdependence (Doda,George, and MacEwin, 1987).

Research by Yvonne Meichtry in 1990 focused on the effects of interdisciplinary teaching on teacher interactions and classroom practices. Observations and interviews revealed a high degree of collaboration in planning, instruction and evaluation, and a significant degree of personal support. This collaboration was accompanied by changes in the classroom behavior of the team members, with increased reflection about alternative methods of instruction and the sharing of content knowledge.

According to Alexander and George, the collegiality fostered by the interdisciplinary instruction serves as a model for students of effective group behavior: "Early adolescents need to see adults working together cooperatively. If there is not interdisciplinary team organization in the school, young people may not witness collaborative relationships among adults at all" (1981, p. 136).

Research on Interdisciplinary Programs

The rationale for interdisciplinary teaching as an effective curriculum construct is rich; the empirical evidence supporting it is sparse. Few substantive studies of the effects of interdisciplinary teaching on middle level students' achievement have been conducted. Most of the studies that have been completed are of such weak design and/or contain such ambiguous findings that their value for generalization is extremely limited. Two major conundrums contribute, in large part, to the difficulties researchers encounter when designing studies to test the impact interdisciplinary teaching has on student learning: (1) unclear definition of the term *interdisciplinry teaching*, and (2) inabilities to isolate interdisciplinary teaching from other, closely related, variables that affect student learning.

The major limitation to generalization lies in the vagueness of the term "interdisciplinary teaching." In her 1982 review of the literature, Kathleen Cotton examined thirteen studies and three large-scale reviews to assess the effectiveness of interdisciplinary team teaching in enhancing student achievement. The results were generally inconclusive: of the seventy-five programs reviewed, forty-four found no significant difference between interdisciplinary and traditional teaching, twenty found differences favoring team teaching, and twelve found differences favoring the traditional approach (Cotton, 1982). Examination of one study included in the review, however, revealed that the program included a **team** of teachers but was not interdisciplinary in any way (Zweibelson, Bahnmuller, and Lyman, 1965). Obviously this study sheds no light on the value of interdisciplinary teaching and raises questions about the inclusion of other studies in the report.

In some cases the emphasis of an interdisciplinary team approach is placed on the

teaming, itself, as a social organization of students and teachers rather than curriculum organization. In her review of interdisciplinary teaming and the social bonding of middle level students, Arhar (1992) concludes that "teaming creates conditions that are directly related to student social bonding" (p. 157). The structure and dynamics of teacher-teacher and student-teacher interactions are of foremost importance; the integrated curriculum is the structure promoting the interactions. "It appears as if teaming is a manifestation of a commitment on the part of teachers to engage in teacher-student relationships that facilitate growth and individual student development. That teaming causes the philosophical commitment is unlikely; that it gives teachers the ability to translate this commitment into action is almost certain" (Arhar, 1992, p. 157).

A second limitation in the research on interdisciplinary teaching is the failure to limit variables to permit isolation of factors correlated to student performance. For example, one successful middle school program cited by the Carnegie Council on Adolescent Development (1989) is lauded for its interdisciplinary team approach. According to the report, "In 1987, when standardized test scores across the city went up an average of 8 percentile points, Timilty's scores, although still low, went up 17 points in the 6th grade, 19 in the 7th, and 7 in the 8th. . . . Teaming at Timilty is one of the keys to a school that works" (p. 39). While interdisciplinary teaming may be one factor in student achievement, Timilty also incorporates an extended school day, a half-day Saturday program, increased pay for teachers selected to participate in the program, flexible scheduling, and ample teacher planning time. Isolating the integration of curriculum to evaluate its effectiveness may not be possible. Therefore, researchers may need to rely on multiple variable constructs and use structural model equations to interpret complex relationships among the variables that empact student learning to study appropriately and answer correctly the seemingly direct question.

In an experimental study on the effects of a thematically integrated curriculum (Project THEME) administered to "at-rilsk" Hispanic seventh graders at the Pajaro Middle School in California, "consistent positive comparative academic outcome data favor[ing] the student participants of the THEME intervention" (Garcia, 1991, p. 10) were found. The author identifies a number of constraints of the study, however: the volunteers were self-selected and "particularly motivated," and the number of intervention variables make it difficult to specify causal links. THEME students, for example, were provided peer tutoring, cooperative learning, after-school supportive activities, parental involvement, and heterogenous groupings -- all variables that could have influenced student learning. Again, integration of the curriculum was not isolated for study as a single independent variable, nor could it have been because the Project THEME intervention program was made-up of all of these components.

A similar design flaw limits the value of a study comparing the effectiveness of interdisciplinary and departmentalized organization in a selected seventh grade (Bradley, 1988). In addition to the change in curriculum approach, students on the interdisciplinary team were scheduled for a minimum of three extra periods per week with their team teachers for "additional help, make-up classes, enrichment activities and study periods" (p. 95). Teachers on the interdisciplinary team taught four academic periods instead of the normal five in order to conduct the team-needs period. In addition to the extra tutoring received, students on the interdisciplinary team were grouped heterogeneously rather than homogeneously as they were in the departmentalized classes. Additional variables such as these pervade most studies, leading one to conclude that interdisciplinary teaching, by its nature, may be a function of more than one teaching technique. It that is the case, multivariate analyses (not applied in these studies) would be the appropriate statistical tool to use, and the research question would ask, "What types of interdisciplinary teaching are associated with student learning?"

In many cases the evidence for interdisciplinary teaching is anecdotal rather than empirical. The Cardigan Unit is a ten-week integrated curriculum for eighth-graders, focusing on the environment and culminating in a four-day camp (Carper, 1991). Teacher assessment of the program is that it is "a vital, interesting, motivating educational experience for children in which a lot of learning took place" (p. 40), but no formal assessment compares it to traditional instruction. In a similar anecdotal report, teachers from Newtown High School described a year-long humanities course as "humanizing" and "beneficial" (Jacobs, 1989, p. 45), but no data are included. Such reports are encouraging but fail to provide the empirical evidence needed to motivate most educators to change.

A well-constructed pilot study on the integration of writing and mathematics in ninth grade classrooms showed a positive correlation between the interdisciplinary approach and student achievement (Bell and Bell, 1985). The hypothesis was generated from the assumption that there was a relationship between mathematical problem solving and expository writing as a mode of learning. Students in both the experimental and control groups were presented with identical content (problem-solving process, problem analysis, devising student-made problems) but the experimental group students were also required to formally record the problem-solving steps they experienced. The guided expository writing encouraged students to be aware of their thinking processes and helped integrate the methodology of two traditionaly separate disciplines.

The groundswell of journal articles from curricular areas and middle level practitioners highlights the increasing popularity of interdisciplinary teaching. With few exceptions, however, most support for interdisciplinary teaching must be extrapolated. Studies of science programs incorporating a Science/Technology/Society or similar issues-based curricula, for example, have shown positive student responses (Yager,1988) and improved student performance (Holdzkom and Lutz,1989). As previously mentioned, interdisciplinary team organization is a central

feature of 90% of the exemplary middle schools described by George and Oldaker (1985). There is an increased recognition of the need for interdisciplinary material: the National Middle School Association's Delphi Study called for textbook publishers to develop "problem-centered issues-oriented materials to facilitate real cross-disciplinary learning" (Jenkins and Jenkins, p.64).

Conclusion

Despite connotative ambiguities surrounding the definition of *interdisciplinary teaching*, conventional wisdom espoused by many middle level educators touts its efficacy as an instructional method. Data from the few experimental and quasi-experimental studies that have examined these changes generally indicate that student achievement is enhanced. Difficult to separate from other instructional practices for empirical examination, interdisciplinary teaching may necessitate other curricular, instructional, organizational, and attitudinal changes.

More (and different) research is needed. To isolate interdisciplinary teaching as a single, causal variable a design meeting two conditions should be employed. First, random selection of subjects is needed. Second, the "baggage" of variables associated with and/or connected to interdisciplinary teaching needs to be "accounted for".

Research suggests that presenting material in an integrated fashion, showing connections and relationships among various components of learning, may improve students' ability to solve problems, employ critical thinking skills, and evaluate, analyze, and synthesize information. Further, this technique may be most beneficial for young adolescent learners who are beginning to move from concrete to formal operational thinking.

The complex interactions that take place between students and teachers are related to learning. Assuming that no two teachers present identical lessons in identical fashion, it would

be more logical to examine the impact interdisciplinary teaching has on student learning by studying it either as many different methods or as a generic unifying or integrating technique used when information is presented. In either approach the specific content of any given lesson or unit would be less important than the integrating theme or common thread used to demonstrate the natural connections of the content.

Finally, if interdisciplinary teaching is linked to increased problem solving abilities among young adolescents, what is the causal path? Does making logical connections between / among content demonstrate relevance to the universe of life and learning? Do these connections relate to the young adolescent's world? Does this relationship engange the learner more fully to motivate learners? Does this motivation steeped in a sense of self - world "connnectedness" lead to increased learning? And what type of learning (e.g., problem solving) is impacted most? These are some of the key questions in need of examination.

Bibliography

Alexander, W. M., & George, P. S. (1981). *The exemplary middle school*. NY: Holt, Rinehart and Winston.

Arhar, J. (1992). Interdisciplinary teaming and the social bonding of middle level students. In Irvin, J. L. (Ed.) *Transforming middle level education*. Boston: Allyn and Bacon, Inc.

Bachofer, K. V., & Borton, W. M. (1992, Feb.). *Restructuring: A view from the trenches. The continuing evolution of O'Farrell Community School*. Center for advanced academic studies. Assessment and Evaluation Department, Planning, Research, and Evaluation Division, San Diego C. Schools.

Beane, J. A. (1992). Turning the floor over: Reflections on a middle school curriculum. *Middle School Journal, 23*(3), 34-40.

Beane, J. A. (1986). A human school in the middle. *The Clearing House, 60*(1), 14-17.

Bell, E. S., & Bell, R. N. (1985). Writing and mathematical problem solving: Arguments in favor of synthesis. *School Science and Mathematics, 85*(3), 210-221.

Berlin, D. F., & Jones, S. (1987). The integration of science and mathematics: Early childhood and middle school levels. *School Science and Mathematics, 87*(4), 271-285.

Berlin, D. F. (1989). The integration of science and mathematics education: Exploring the literature. *School Science and Mathematics, 89*(1), 73-79.

Boyer, E. (1991). Seeing the connectedness of things. *Educational Leadership, 39*(8), 582-584.

Bradley, E. M. (1988). The effectiveness of an interdisciplinary team organizational pattern compared with a departmentalized organizational pattern in a selected middle level school setting. In D.B. Strahan (Eds.), *Middle school research: Selected studies* (pp. 85-111). Columbus, OH: National Middle School Association Research Committee.

Bybee, R. W., & Bonnstetter, R. J. (1987). What research says: Implementing the science-technology-society theme in science education: Perceptions of science teachers. School *Science and Mathematics, 87*(2), 144-152.

Capelluti, L., & Stokes, D. (Eds.) (1991). *Middle level education: Programs, policies, & practices*. Reston, VA: National Association of Secondary School Principals.

Carnegie Council on Adolescent Development. (1989). *Turning points: Preparing American youth for the 21st century*. Washington, D.C.: Carnegie Corporation.

Carper, C. E. (1991). The Cardigan experience--An eighth grade integrated curriculum. *Middle School Journal*, 23(2),36-40.

Champagne, A. B., & Klopfer, L.E. (1981). Problem solving as outcome and method in science teaching: Insights from 60 years of experience. *School Science and Mathematics, 81*(1), 3-8.

Cotton, K. (1982, February). *Effects of interdisciplinary team teaching. Research synthesis.* Portland, OR: Northwest Regional Education Lab. (ERIC Documentation Reproduction Service No. ED 230 533)

Doda, N., George, P., & McEwin, K. (1987). Ten current truths about effective schools. *Middle School Journal, 18*(3), 3-5.

Eccles, J.S. , & Midgely, C. (1989). "Stage/Environment Fit: Developmentally Appropriate Classrooms for Early Adolescents." In *Research on Motivation in Education*, vol. 3, ed. by R.E. Ames and C. Ames. N.Y.: Academic Press, 1988.

Eichhorn, D. H. (1983). Focus on the learner leads to a clearer middle level picture. *NASSP Bulletin, 67*(463), 45-48.

Eichhorn, D. H. (1984). The nature of transescents. In Lounsbury, J. H. (Ed.) *Perspectives: Middle school education, 1964-1984*, pp. 30 - 38. Columbus, Ohio: National Middle School Association.

Epstein, H. T. (1974). Phrenoblysis: Special brain and mind growth periods. *Developmental Psychobiology, 7*(3), 217-224.

Epstein, H. T., & Toepfer, C. F. (1978). A neuroscience basis for reorganizing middle grades education. *Educational Leadership, 36*, 656-660.

Epstein, J. L., & Mac Iver, D. J. (1989, March). Education in the middle grades: Overview of a national survey of practices and trends. Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA.

Fisher, D. L., & Fraser, B. J. (1983, April). Use of classroom environment scale in investigating effects of psychosocial milieu on science students' outcomes. Paper presented at the Annual Meeting of the National Association for Research in Science Teaching, Dallas, TX. (ERIC Documentation Reproduction Service No. ED 228 062)

Garcia, E. E. (1991,April). An analysis of literacy enhancement for middle school hispanic students through curriculum integration. Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, IL.

George, P. S., & Oldaker, L. L. (1985). *The evidence for the middle school.* Columbus, OH: The National Middle School Association.

George, P. S., Stevenson, C., Thomason, J., & Beane, J. (1992). *The middle school--and beyond*. Alexander, VA: Association for Supervision & Curriculum Development.

Hart, E. P., & Robottom, I. M. (1990). The science-technology-society movement in science education: A critique of the reform process. *Journal of Research in Science Teaching, 27*(6), 575-588.

Henderson, R. W., Landesman, E. M., & Marshall, M. (1991, April). Attitudes, motivational goal structures, and mathematics achievement among Chicano/Latino middle school students: The effects of thematically integrated instruction. Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, IL.

Hester, J. P., & Hester, P. J. (1983). Brain research and the middle school curriculum. *Middle School Journal, 15*(1), 4-7.

Holdzkom, D., & Lutz, P. (1989). *Research within reach: Science education*. Washington, D.C.: National Science Teachers Association.

Hough, D. (1989). *Vertical Articulation for the Middle Grades*. Riverside, CA: California Educational Research Cooperative. (ERIC Documentation Reproduction Service No. ED 315 896),

House, P. A. (1990). Mathematical connections: A long-overdue standard. *School Science and Mathematics, 90*(6), 517-527.

Irvin, J. L. (1992). Developmentally appropriate instruction: The heart of the middle school. In Irvin, J. L. (Ed.) *Transforming middle level education: Perspectives and possibilities*. Boston: Allyn and Bacon.

Jacobs, H. H. (Ed.) (1989). *Interdisciplinary curriculum: Design and implementation*. Alexandria, VA: Association for Supervision and Currriculum Development.

Jackson, A. W., & Hornbeck, D. W. (1989) Educating young adolescents: Why we must restructure middle grade schools. *American Psychologist, 44*(5), 831-836.

Jenkins, K., & Jenkins, D. (1992). *Current imperatives for 21st century middle schools*. Columbus, OH: National Middles School Association, 1(1),

Johnston, J. H., & Markle, G. C. (1986). *What research says to the middle level practitioner*. Columbus, OH: The National Middle School Association.

Jones, M. G. (1991, April). The impact of transition from junior highs to middle schools on science programs. Paper presented at the Annual Meeting of the National Association for Research in Science Teaching, Lake Geneva, WI. (ERIC Documentation Reproduction Servi e No. ED 340 604)

Kleiman, G. M. (1991). Mathematics across the curriculum. *Educational Leadership, 49*(2), 48-51.

Lewis, C. (1981,September). Oaklea Middle School: Interdisciplinary team teaching at its best. Eugene, OR: Oregon School Study Council. (ERIC Document Reproduction Service No. ED212 069)

Linn, M. C., & Songer, N. B. (1991). Cognitive and conceptual change in adolescence. *American Journal of Education, 99*(4), 379-417.

Lippert, R. (1987). Teaching problem solving in mathematics and science with expert systems. *School Science and Mathematics, 87*(6), 477-493.

Loucks-Horsley, S., Brooks, J. G., Carlson, M. O., Kuerbis, P., Marsh, D., Padilla, M., Pratt, H., & Smith, K. L. (1990). *Developing & supporting teachers for science education in the middle years.* Colorado Springs, CO: National Center for Improving Science Education Biological Sciences Curriculum Study (BSCS).

Lounsbury, J. H., & Vars, G. F. (1978). *A curriculum for the middle school years.* NY: Harper & Row.

Lounsbury, J. H. (1991). The middle school curriculum--or is it curricula?. In J. Capelluti, & D. Stokes (Eds.), *Middle level education: Programs, policies, & practices* (pp. 12-18). Reston, VA: National Association of Secondary School Principals.

Mac Iver, D. J. (1990). Meeting the needs of young adolescents: Advisory groups, interdisciplinary teaching teams, and school transition programs. *Phi Delta Kappan, 71*(6), 458-464.

Mac Iver, D., & Reuman, D. (1988, April). Decision-making in the classroom and early adolescents' valuing of mathematics. Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, LA. (ERIC Documentation Reproduction Service No. ED 302 428)

Marzano, R. J. (1992). *A different kind of classroom: Teaching with dimensions of learning.* Alexandria, VA: Association for Supervision & Curriculuim Development.

Matute-Bianchi, G., & Pease-Alvarez, L. (1991, April). Project Theme: Students' perspectives. Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, IL.

McPartland, J. M. (June, 1987). Balancing high quality subject-matter instruction with positive teacher-student relations in the middle grades: Effects of departmentalization, tracking and environments. Report No. 15. Washington, D.C.: Office of Educational Research and Improvement. (ERIC Document Reproduction Service No. ED 291 704)

Meichtry, Y. J. (1990, October). Teacher collaboration: The effects of interdisciplinary teaming on teacher interactions and classroom practices. Paper presented at the Annual Meeting of the Mid-Western Educational Research Association, Chicago, IL. (ERIC Documantation Reproduction Service No. ED 326 499)

Metcalf, F. (1991). Revising the social studies curriculum for the next decade. *NASSP Bulletin, 75*(531), 7-13.

Midgley, C., et al. (1988). *Student/teacher relations and attitudes toward mathematics before and after the transition to junior high school.* Ann Arbor; Michigan University, Institute for Social Research.

National Council of Teachers of Mathematics. (1989). *Curriculum and evaluation standards for school mathematics.* Reston, VA: NCTM.

North Carolina State Department of Public Education. (1987). *Integrated learning what--why--how?* (Instructional Services Curriculum Series, No.1). Raleigh, NC: Author.

Perkins, D. N. (1991). Educating for Insight. *Educational Leadership, 49*(2), 4-8.

Plodzik, K. T., & George, P. (1989). Interdisciplinary team organization. *Middle School Journal, 20*(5), 15-17.

Relan, A., & Kimpton, R. (1991,April). Curriculum integration: A critical analysis of practical and conceptual issues. Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, IL. (ERIC Document Reproduction Service No. ED 334-677.

Roy, R. (1985). The science/technology/society connection. *Curriculum Review, 24*(3), 12-23.

Rutherford, F. J., & Ahlgran, A. (1990). *Science for all Americans.* American Association for the Advancement of Science, Inc. New York: Oxford University Press.

Savage, R. J. (1991). A principal's perspective on social studies in the middle level school. *NASSP Bulletin, 75*(531), 53-59.

Stipek, D., & Mac Iver, D. (1989). Developmental change in children's assessment of intellectual competence. *Child Development, 60*, 521-538.

Stonewater, J. K., Stonewater, B. B., & Perry, B. E. (1988). Using develpmental clues to teach problem solving. *School Science and Mathematics, 88*(4), 272-283.

Strahan, D. B., & Toepfer, C. F. (February, 1984). Transescent thinking: Renewed rationale for exploratory learning. *Middle School Journal, 15*(2), 8-11.

Strubbe, M. (1990). Are interdisciplinary units worthwhile? Ask students! *Middle School Journal, 21*(3), 36-38.

Superintendent's Middle Grade Task Force. (1987). *Caught in the Middle: Educational reform for young adolescents in California public schools.* Sacramento, CA: California State Department of Education.

Task Force on Social Studies in the Middle School. (1991, January). Social studies in the middle school: A report of the task force on social studies in the middle school. Washington, D.C.: National Council for the Social Studies. (ERIC Documentation Reproduction Service No. ED 340 646)

Thomason, J., & Thompson, M. (1992). Even if it isn't broken: A proposal for wholesale change. *Middle School Journal, 23*(5), 10-14.

Toepfer, C. F. (1981). Brain growth periodization: Implications for middle grade education. *NASSP--Schools in the middle; a report on trends and practices.* Reston, VA: National Association of Secondary School Principals.

Toepfer, C. F. (January, 1992a). Curriculum for identity: A middle level educational obligation. *Middle School Journal, 23*(3), 3-10.

Toepfer, C. F. (1992b). Middle school curriculum: Defining the elusive. In Irvin, J. I. (Ed.) *Transforming middle level education: Perspectives and possibilities.* Boston: Allyn and Bacon.

Tyler, R. W. (1949). *Principles of curriculum and instruction.* Chicago: University of Chicago Press.

Vars, G. F. (Ed.) (1969). *Common learnings: Core and interdisciplinary team approaches.* Scranton, PA: International Textbook Company.

Vars, G. F. (1992). Integrative curriculum: A de'ja' vu. *Current Issues in Middle Level Education, 1*(1), 66-78.

Yager, R.E. (1988). Comparison of perceptions: Exemplary science and random programs. *School Science and Mathematics, 88*(1), 37-45.

Yeotis, C. and Hosticka, A. (1980). Promoting the transition to formal thought through the development of problem solving skills in middle school mathematics and science curriculum. *School Science and Mathematics. 80*(705) 557-565.

Zweibelson, I., Bahnmuller, M., & Lyman, L. (1965). Team teaching and flexible grouping in the junior high-school social studies. *The Journal of Experimental Education, 34*(1), 20-25.